(12) **UK Patent Application** (19) **GB** (11) **2 289 018** (13) **A**

(43) Date of A Publication 08.11.1995

(21) Application No 9508647.6

(22) Date of Filing 28.04.1995

(30) Priority Data
(31) 4415486 (32) 03.05.1994 (33) DE

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(51) INT CL⁶
B41F 33/00 // G01J 3/46

(52) UK CL (Edition N)
B6C CVE C1200 C1230 C1249 C1280 C1284

(56) Documents Cited
GB 2160385 A   EP 0600335 A1   US 5218555 A
US 5182721 A   US 5023812 A   US 4967379 A

(58) Field of Search
UK CL (Edition N) B6C CVE CVG CVK CVSX CVU
CWE CWG CWK
INT CL⁶ B41F 33/00
ON-LINE: WPI

(54) Determination of tolerances in the control of inking on a printing press

(57)   In a process for determining automatically the tolerances for the control (open-loop or closed-loop) of inking, the tolerances being independent of the type and colour composition of measuring points and not requiring any measuring elements to be co-printed the distribution of colour coordinates, corresponding to a printed image, in the associated colour space is determined with the aid of a computer (5, 9), and from the type of distribution, assignment is automatically made, in accordance with selected criteria, to one of a plurality of colour-difference tolerance classes.

The invention can be used in multi-colour printing presses in which it is necessary to select tolerances for the inking on a stock.
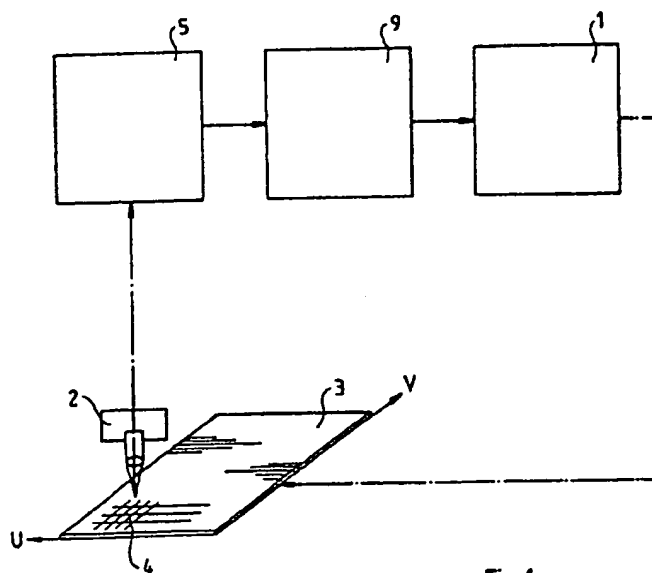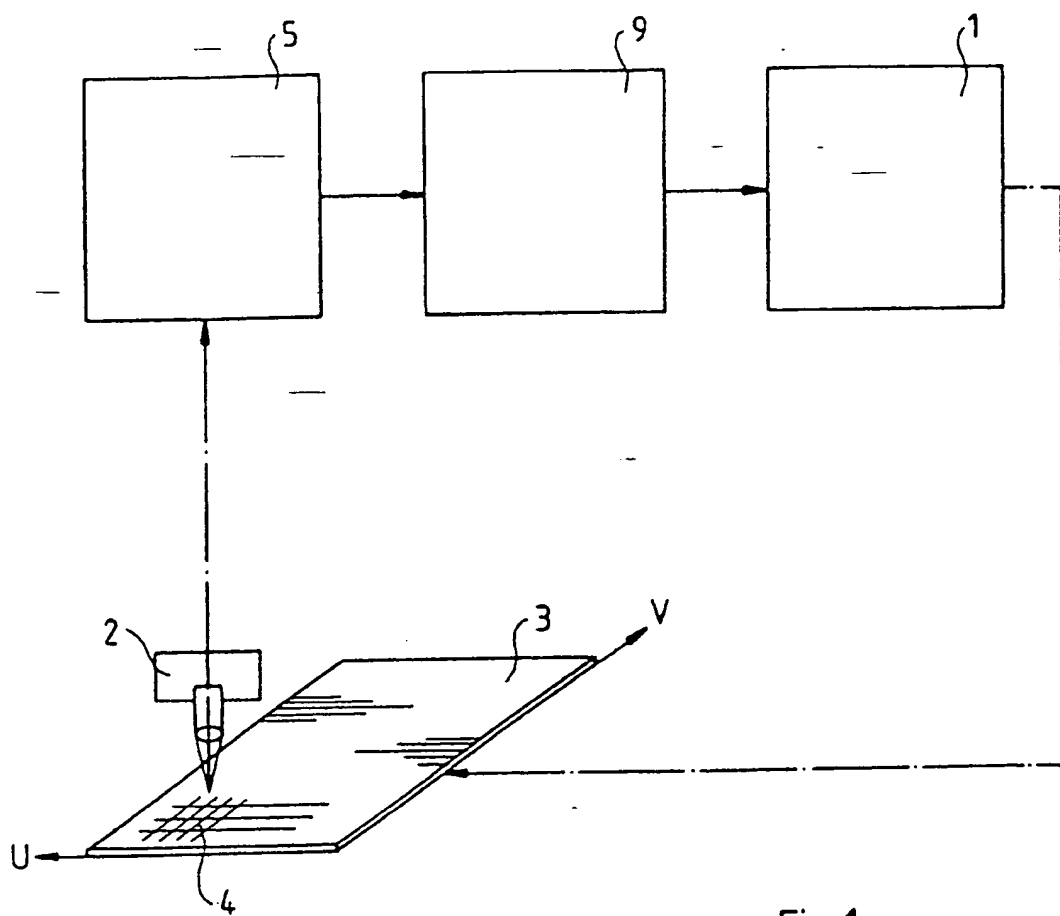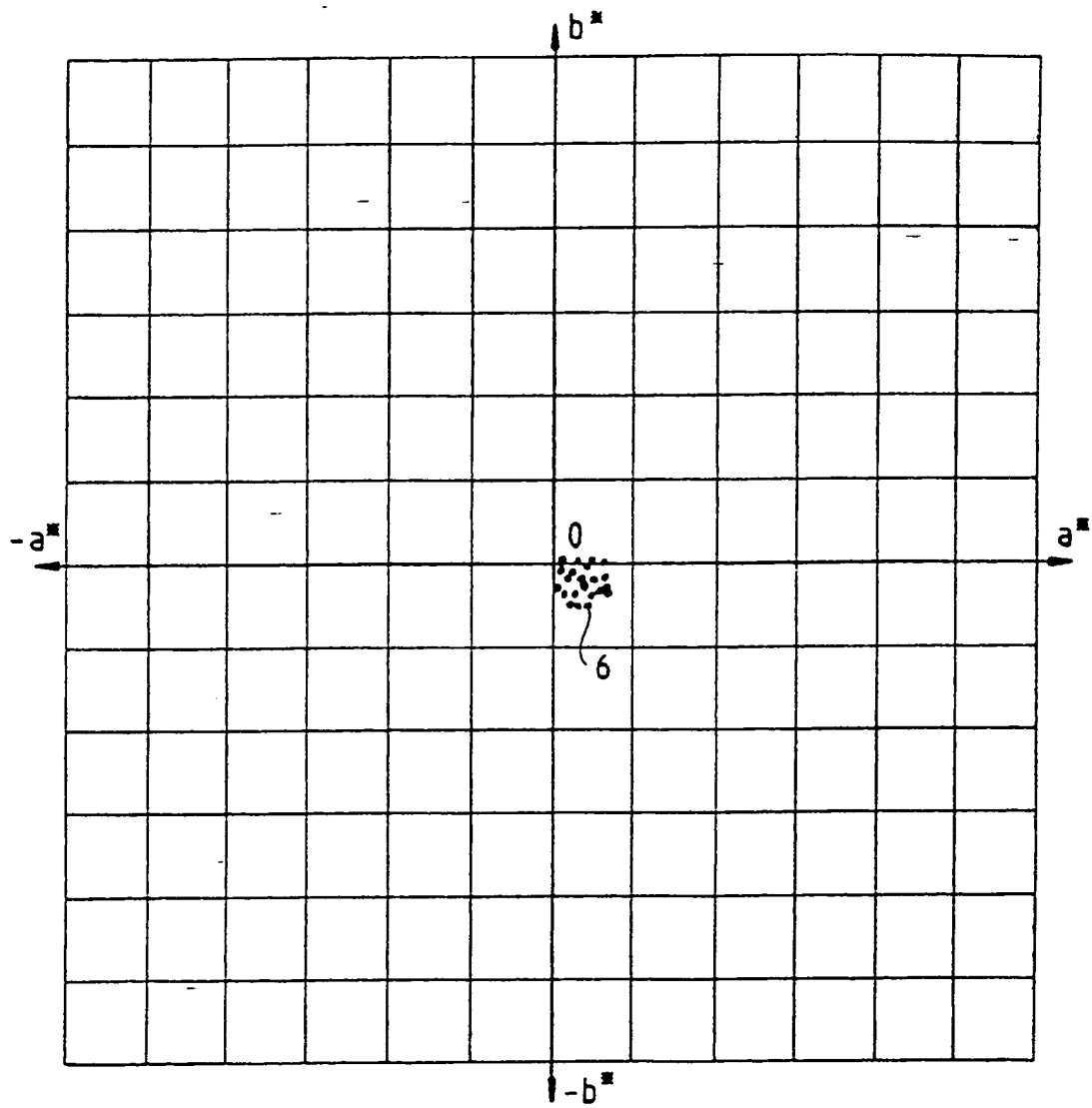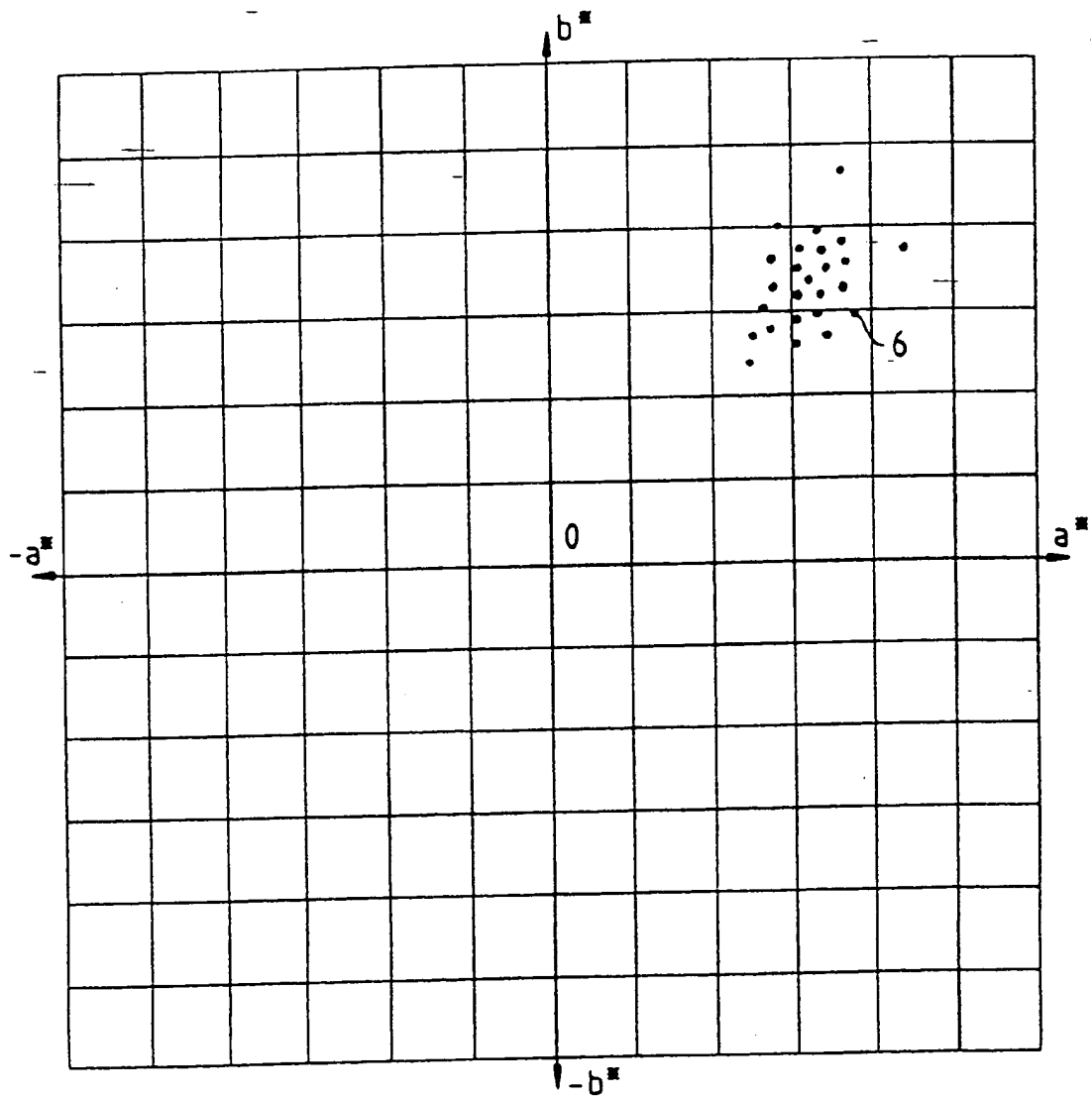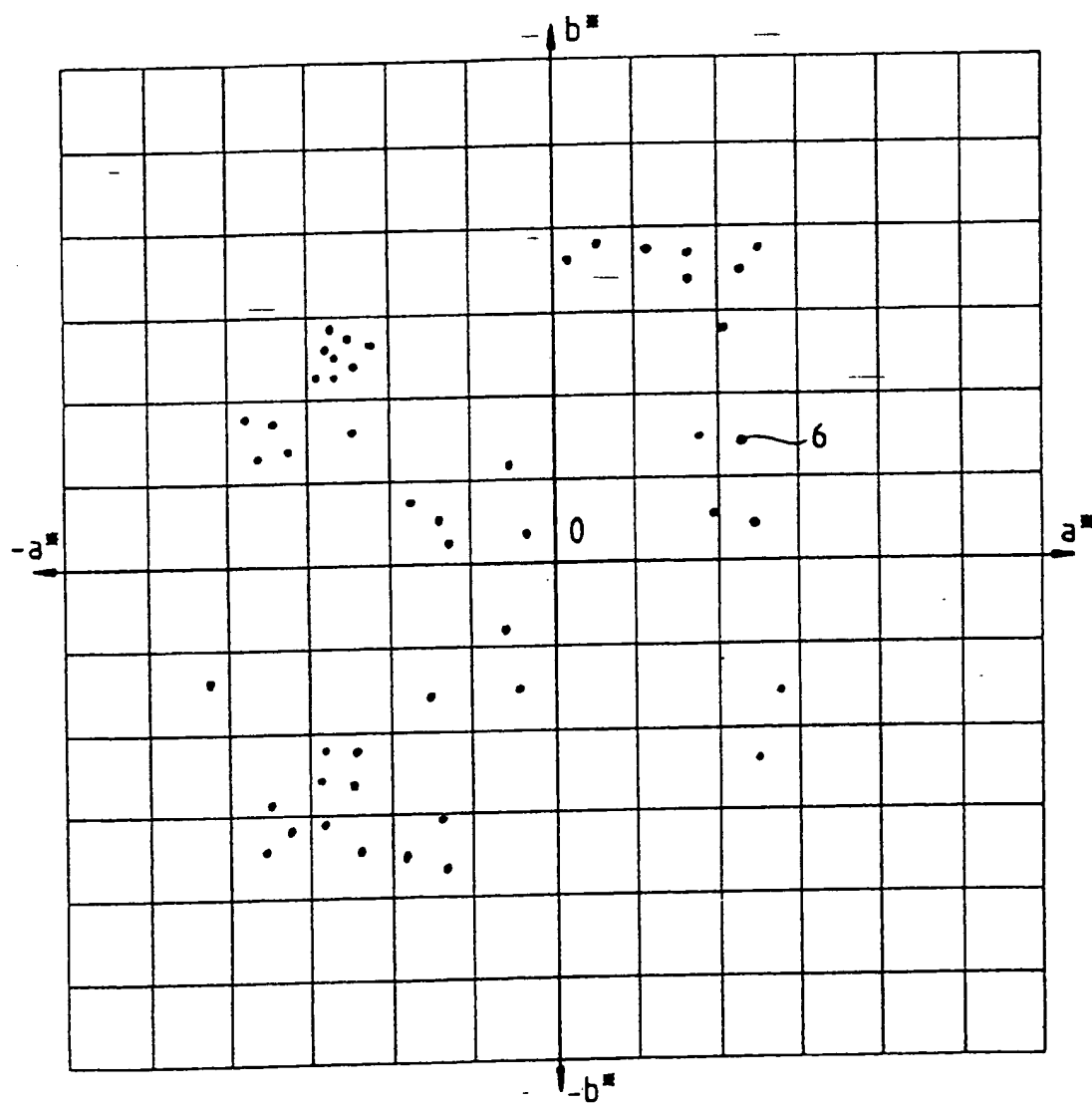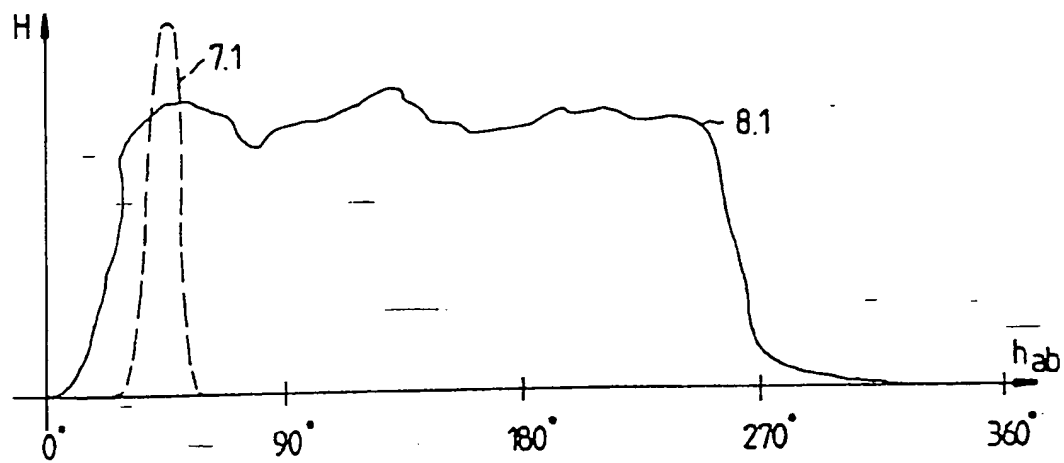
Fig.1

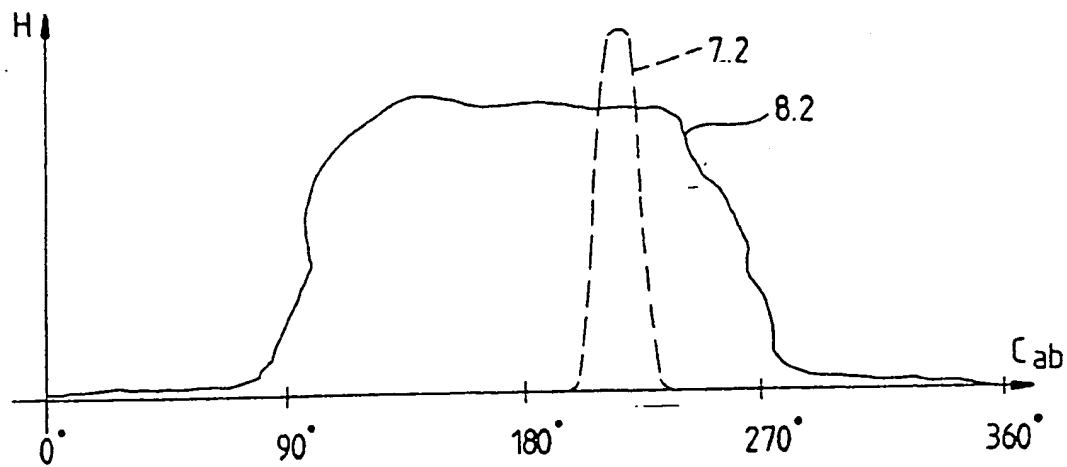GB 2 289 018 A

Fig.1

Fig.2

Fig. 3

Fig.4

Fig.5

Fig.6

PROCESS FOR DETERMINING THE PERMISSIBLE TOLERANCES
FOR THE CONTROL OF THE INKING ON A PRINTING PRESS

This invention relates to a process for determining the permissible tolerances for the control (open-loop or closed-loop) of the inking on a printing press.

The invention can be used in multi-colour printing presses in which it is necessary to select tolerances for the inking on a stock.

The invention can be used in multi-colour printing presses in which it is necessary to select tolerances for the inking on a stock.

European patent specification EP 0 196 431 B1 describes a process for obtaining a uniform printed result in which so-called selected relationships between ink-film thicknesses and/or dot sizes of different printing inks are kept within tolerance ranges assigned to said relationships. The size of the tolerance ranges is specified for defined measuring fields and is monitored by densitometric measurement of corresponding, co-printed measuring fields. In order to determine the size of the tolerance ranges, once-selected test prints are produced that are selectively changed in their optical appearance. The test images are selected according to previously specified image-contrast classes. Measurement of the measuring fields, co-printed with the test images, on the limit test images, determined by visual selection, results in a group of tolerance ranges that are assigned to the respective image-contrast class. Images currently to be printed are then assigned to one of these image-contrast classes, e.g. by visual comparison with specimen images for which the image-contrast class has been specified. Thus, the numerical values for the tolerances of the selected relationships are inputted into an ink-control system. The control variables for the inking-adjustment elements are then derived from a comparison of the

actual values with the tolerances or setpoint values of the selected relationships.

The process takes account of the fact that human perception is more critical in its evaluation of equal colour differences in images with a low colour contrast, such as images with predominant grey areas, than in images with a high colour contrast, such as the image of a meadow in blossom.

This process exhibits a number of disadvantages: first of all, it is necessary, for each desired image-contrast class, to print test images with different inking, this involving a certain outlay in terms of time and cost. The evaluation of the test images with regard to the determination of the limit specimens is performed visually and is therefore dependent on personal perception. In order to restrict individuality, it is necessary to use a number of test persons with normal colour vision. Furthermore, it is necessary, from the determined limit specimens of each image-contrast class, to determine and store the permissible tolerances for the co-printed measuring fields, with them thereafter being valid only for those measuring fields. During production printing, it is still necessary to employ colour-control strips which contain the measuring fields for which the tolerances have been determined. The tolerances must be determined and stored for different grades of paper. In order to specify the corresponding tolerance group, the images that are to be printed must be assigned before the start of printing to one of the image contrast classes by means of a visual comparison with specimen images. This calls for a catalogue of image specimens. Finally, the tolerances that have been determined according to this process cannot be used for measuring in the printed image.

Proceeding therefrom, the object of the invention is to
indicate a process for determining the tolerances for
the control (open-loop or closed-loop) of the inking,
said process permitting the automatic and reliable
determination of tolerances, said tolerances being
independent of the type and colour composition of
measuring points and use thereof not requiring any
measuring elements to be co-printed.

The object of the invention is achieved in that the
distribution of the colour coordinates, reproducing a
printed image, in the associated colour space is
determined with the aid of a computer, and in that, from
the type of distribution, assignment is automatically
made, in accordance with selected criteria, to one of a
plurality of colour-difference tolerance classes.

In contrast to the solution from the prior art, the
tolerances are obtained not by visual assignment to an
image class, but automatically on the basis of colour
coordinates of the image to be printed. Since the
tolerances are determined on an image-specific basis,
different tolerances can be allocated for the inking
control with regard to the individual images of a
printed sheet. Since, moreover, in contrast to the
above-outlined prior art, these are ink-difference
tolerances, they apply equally to each image element
irrespective of the dot percentages and number of
printing inks involved.

The colour coordinates, preferably the colorimetric
coordinates, may be obtained from image signals, said
image signals being generated by an image-recording
apparatus directed onto the printed image. The image-
recording apparatus may be disposed inside or outside a

printing press. There is no need for special measuring elements.

The colour coordinates may also be obtained from process stages prior to the printing process. If the data there is not colorimetric, but, for example, RGB or CMYK data, this can preferably be converted to colorimetric data using known computing techniques. The computer may be integrated into a control device (open-loop or closed-loop) for inking, said control device being associated with the printing press.

The colour coordinates of the entire printed image or of parts thereof may be used for determining the tolerances.

Since differences in brightness play no essential role in the evaluation of the colour contrasts of an image, the colour-difference tolerance classes may be determined with exclusion of the colorimetric brightness coordinate. This makes it possible to determine the type of distribution of the colorimetric coordinates in the colour plane. This simplifies and speeds up determination.

The type of distribution of the colour coordinates may be determined either for an entire printed image or with reference to smaller areas. In this manner, it is possible to determine even small image areas with a low colour contrast and to coordinate therewith the assignment of the tolerance classes.

Hereinbelow, the invention is to be explained in greater detail on the basis of a specimen embodiment with reference to the drawings, in which:

Fig. 1   shows a diagram of an arrangement for the
          determination of colour-difference tolerances;

Fig. 2   shows an a-b colour chart for an image with low
          colour contrast;

Fig. 3   shows an a-b colour chart for an image with
          medium colour contrast;

Fig. 4   shows an a-b colour chart for an image with
          high colour contrast;

Fig. 5   shows a graph of frequency distributions of the
          colour-tone angle; and

Fig. 6   shows a graph of frequency distributions of the
          chroma.

In a multi-colour printing press, a control device 9 for
inking is provided. Let the inking be closed-loop-
controlled using a process as described in EP 0 228 347
B1.

The inking-control system must be provided with colour-
difference tolerances within which the inking is allowed
to vary. The tolerance must be greater than the
process-specific fluctuations and smaller than the
fluctuations that are perceived as being disturbing by
an observer of the printed image. Whether differences
in inking are perceived as being disturbing is heavily
dependent on the colour contrast of the subject. The
lower is the colour contrast in the subject, the smaller
the tolerance must be.

For automatic determination of the permissible ink-
difference tolerances of a print job, as shown in

Fig. 1, a printed sheet 3 is measured, image element by image element, by means of an image-recording apparatus 2 disposed after the last printing unit of a printing press 1. Let the image elements 4 be, for example, 0.5 x 0.5 mm² in size. Colorimetric coordinates XYZ are determined in a computer 5 for each image element 4, prefereably in a perceivedly equally spaced colour space, for example converted into an Lab colour space and stored, for example, as a function of the position coordinates U, V.

The analysis of the colorimetric-chroma coordinates a and b for determination of the colour-difference tolerance is also performed in the computer 5. For example, the a and b colour coordinates, determined for the entire printed sheet 3, are plotted in an a-b colour-chart, as shown in Fig. 2. Each entered dot 6 denotes a measured value. The example in Fig. 2 shows that the image has a low colour contrast and is near to the grey axis or brightness axis L, which stands perpendicular on the origin of the a*-b* coordinates. The image requires a narrow permissible colour-difference tolerance.

Fig. 3 shows an image that is likewise of low colour contrast, but which is more coloured than the image with the colour coordinates in Fig. 2.

Fig. 4 shows an image with high colour contrasts, for which greater colour-difference tolerances are permissible. It can be seen that this kind of representation permits in simple manner the analysis of the colour contrast.

Explained hereinbelow is a method, representative of many others, for the computational evaluation:

The colorimetric cartesian coordinates a and b are converted to the polar coordinates h_{ab} for the colour-tone angle and c_{ab} for the chroma according to German Industry Standard DIN 5033, Part 3. The frequencies H thereof are determined in histograms according to Fig. 5 and 6. The curves 7.1 and 7.2 correspond to the printed image according to Fig. 3, while the curves 8.1 and 8.2 correspond to the printed image according to Fig. 4. By defining frequency thresholds and by specifying band widths for h_{ab} and c_{ab} it is possible to assign tolerance groups, e.g. narrow, medium, wide. For simplification, assignment is also possible only with reference to the colour-tone angle h_{ab}, since, basically, the colour-tone angle h_{ab} characterizes the chrominance, whereas the chroma c_{ab} is an image of the saturation. In order to prevent abrupt assignment limits, the methods of fuzzy logic may be used.

Values are stored in memory for the colour-difference tolerance groups which are determined as a function of the colour contrast.

Given hereinbelow are examples of stored colour-difference tolerance groups:

- narrow   where   E = 2.0;
- medium   where   E = 3.5;
- wide   where   E = 5.0.

The control and adjustment data is then computed and outputted in known manner with the aid of the control device 9.

It will of course be understood that the present invention has been described above purely by way of example, and modifications of detail can be made within the scope of the invention.

What is claimed is:

1. Process for determination of the tolerances in the
   control (open-loop or closed-loop) of the inking on
   a printing press,
   c h a r a c t e r i z e d   i n   t h a t
   the distribution of the colour coordinates,
   reproducing a printed image, in the associated
   colour space is determined with the aid of a
   computer
   and in that, from the type of distribution,
   assignment is automatically made, in accordance
   with selected criteria, to one of a plurality of
   colour-difference tolerance classes.

2. Process according to claim 1,
   c h a r a c t e r i z e d   i n   t h a t
   the distribution of the colorimetric coordinates
   (L, a*, b*), reproducing the printed image, of a
   perceivedly equally spaced colour space (L$_{ab}$) is
   determined with the aid of the computer.

3. Process according to claim 1 or 2,
   c h a r a c t e r i z e d   i n   t h a t
   the colour coordinates are obtained from image
   signals, said image signals being generated by an
   image-recording apparatus   directed onto the
   printed image.

4. Process according to claim 1 or 2,
   c h a r a c t e r i z e d   i n   t h a t
   the colour coordinates are obtained from image data
   from a process stage preceding the printing
   process.

5.   Process for determination of the tolerances in the control (open-loop or closed-loop) of the inking on a printing press, and substantially as hereinbefore described with reference to the accompanying drawings.

Patents Act 1977	!O	Application number
Examiner's report to the Comptroller under Section 17 **(The Search report)**		GB 9508647.6

Relevant Technical Fields	Search Examiner C J DUFF
'i) UK Cl (Ed.N) B6C (CVE, CVG, CVK, CVU, CVSX, CWE, CWG, CWK)	
(ii) Int Cl (Ed.6) B41F 33/00	Date of completion of Search 28 JUNE 1995
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) ONLINE: WPI	Documents considered relevant following a search in respect of Claims :- 1-5

Categories of documents

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E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&:   Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages	Relevant to claim(s)
A	GB 2160385 A (DAINIPPON...)	1
A	EP 600335 A1 (HEIDELBERGER....)	1
A	US 5218555 (KOMAI)	1
A	US 5182721 (KIPPHAN)	1
A	US 4967379 (OTT)	1
A	US 5023812 (PFEIFFER)	1

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